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A modified predictor-corrector method for the generalized Burgers–Huxley equation

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Abstract

A third-order in time modified predictor-corrector method is proposed for the numerical solution of the generalized Burgers–Huxley (BgH) equation, which is given by

$$u_t + \alpha u^\delta \, u_x - u_{xx} = \beta u \left(1 - u^\delta\right) \left(u^\delta - \gamma\right) \; ; \; 0 \leq x \leq 1 \, , \; t > 0, \tag{1}$$

$u = u\,(x,t)$ is a sufficiently differentiable function, with α a real parameter, $\beta \geq 0$, $\gamma \in (0,1)$, $\delta > 0$, initial condition $u\,(x,0) = f(x)$; $x \in [0,1]$ and boundary conditions $u_x|_{\,x=0,\,1} = g(t)$; $t > 0$. Eq. (1) is the modified Burgers equation for $\beta = 0$, is the Huxley equation for $\alpha = 0$, $\delta = 1$ and is the Fitzhugh-Nagoma equation for $\alpha = 0$.

Many researchers have used various methods to solve the BgH equation. A theoretical study of the BgH equation was found in [1], while as far as the numerical methods among others in [2] etc.

The main aim of this paper is to solve the BgH equation explicitly with a direct method. To this attempt, the solution of the resulting nonlinear system is given by expressing the unknown vector component wise and updating each component as soon as its value becomes available. This process, which is known as a modified predictor-corrector method (see, e.g., [3] and references therein), opposite to the iterative classical predictor-corrector one is always explicit and is applied once, has also been examined successfully with various other approximations in time giving an improvement in the accuracy over the classical method.

References

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